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ABSTRACT

This paper elaborates on a list of procedures contained in an accompanying handout entitled "The 27 Steps in the Development Program." These 27 steps are subsumed under 12 categories: 1) research and information collecting, 2) planning, 3) develop preliminary form of product, 4) preliminary field testing, 5) main product revision, 6) main field testing, 7) operational product revision, 8) operational field testing, 9) final product revision, 10) dissemination and distribution, 11) report preparation, and 12) implementation. The paper emphasizes the importance of detailed planning with specific objectives. It also justifies the expense of such rigorous development by pointing out the wide applicability of the products and the resulting low unit cost per user. (RT)

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THE R & D PROCESS AS USED IN DESIGNING MINICOURSES

by

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In recent years, education has finally developed a reasonably adequate technology. However, at the present time few people in education have any understanding of the educational R & D process and fewer still have ever applied the process to an educational problem. Many educators still seem to vaguely link educational technology with hardware. In fact, educational R & D is a systematic process that can be followed in designing, building and evaluating an educational product. Although most educational products involves a mix of both human and nonhuman resources, the presence of nonhuman resources such as computers, videotape recorders and the like, is in no way essential to the technological process.

The Teacher Education Program that I have directed at the Far West Laboratory for Educational Research and Development has built an educational technology that has proven to be effective in the design, development, evaluation, and improvement of educational products. I am here today to describe this technology to you and report some of our experience in applying it to the development of specific teacher education materials.

The educational products that we have been developing at the Far West Laboratory are called Minicourses. A Minicourse is a carefully tested and validated educational package designed to help teachers improve specific instructional skills. The typical Minicourse deals with about a dozen highly specific teaching skills. During the 15 hours required to complete

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a Minicourse, the teacher devotes about 4 hours to viewing films which give a precise definition of each skill and show numerous classroom examples of how the skill may be used in regular teaching situations. The remaining 11 hours are devoted to carefully structured teacher practice in simplified teaching situations and self-evaluation and improvement based upon the teacher's analysis of videotape recordings of his own practice lessons.

I believe it will help you to understand the development process that has evolved in the Minicourse program if you first have a clear idea of the products that we are building. Therefore, I would like to show you at this time an 8 minute film which is used to introduce the teachers to our first Minicourse. This Minicourse deals with twelve specific skills related to improving the teachers' effectiveness in carrying out a discussion lesson. (Show the Minicourse 1 introduction film at this time.) You can get an idea of the scope of our program by referring to the handout entitled Minicourses Currently Being Developed.

Now that you have some idea of the kinds of educational products that we are developing, I would like to review with you the specific educational technology that we employ in developing the Minicourses. Let me call your attention to the handout you have received entitled The 27 Steps in the Development Program. This paper briefly outlines our development process and I will refer to it in describing the various steps involved in that process.

Once we have tentatively identified an instructional area in which a Minicourse appears to be needed, our first step is to carry out an exhaustive review of the literature related to this area. The review of the literature

has several purposes. First, of course, it gives us a clear picture of the state of knowledge in the area in which we have chosen to work. Secondly, it provides us with the information we need to clarify our own objectives and carry out the initial planning necessary before moving into development of the product itself. Finally, it identifies gaps in the current state of knowledge. We sometimes find it necessary to carry out small scale research projects to at least partially fill the more critical gaps that we discover.

At this point it seems appropriate to acquaint you with one of the facts of life that one learns very rapidly when carrying out educational development. This fact is that the amount of solid research evidence that we have on any subject in education is not likely to be a sufficient foundation for technological development of a new product or process. Furthermore, there are usually so many gaps in our knowledge that if we delay technological development until a firm and complete foundation of research has been built, we will delay for a very long time. Therefore, development in education at this time must be built on a combination of research evidence, the insight and knowledge of practioners in the field, plus a large dose of common sense.

In planning the development of a new educational process or product, I would emphasize two points. The first is that your initial planning should be as thorough and detailed as possible even though it is likely most of your plans will eventually be changed in the light of experience gained during the actual development and evaluation of your product. Perhaps the most important advantage of a detailed and carefully thought out initial plan is that it gives you a framework upon which changes can

be made as the need for change becomes apparent. A thorough plan is also much more useful in helping you identify places where changes are needed. Sketchy plans usually result in a waste of money and time that could have been avoided if you had adequately thought through your project in advance.

The second point I would make about planning is to emphasize the great importance of building very specific objectives to be achieved by the product or process that you plan to develop. If the product you are building is concerned with teaching behavior as is the case with our Minicourses, you should spell out as thoroughly as possible the specific behaviors that teachers will be able to display as a result of completing the training. Let me give you an example of a specific objective for Minicourse 1. This objective states: "Given a discussion lesson, teachers who complete Minicourse 1 will ask questions which, in at least 50 percent of the cases, will require students to use higher cognitive processes rather than recitation of facts. In order for the course to be successful, this objective will be achieved by at least 75 percent of the teachers taking the course." Although such objectives are difficult to build and may well have to be changed as we learn more about the teaching and learning process, they are still extremely important in technological development. Such objectives provide definite goals which are to be achieved as the product progresses through field testing and evaluation. They also provide the developer with a clear definition of failure. A great advantage of a rigorous development process is that it provides evidence of success or failure. In contrast, most processes and products now in use in education are used year after year without anyone knowing whether they achieve their objectives.

Once planning has been completed, the next step in the technological development of an educational product is to build a prototype. This prototype should be built at a minimum cost and with a minimum of unnecessary embellishments. However, the product should be as good as you are able to build it in its essential elements. Thus, we know that simple clear illustrations tend to help the learning process. We also know, however, that beautifully done color illustrations are of no more value to learning than crudely done black and white illustrations provided only that the latter are clear and understandable.

Once we have developed the preliminary form of our educational product, the next step is to take it to the field and try it out in as realistic conditions as possible. Educational products must be evaluated in terms of their effectiveness under field conditions. Therefore, Laboratory data or data collected under highly artificial field conditions are of limited value. We generally look for two things in field testing a Minicourse. One is the perceptions of the user. His perceptions of the product are very important since a product which is disliked by the user has very little chance of making any real change in the educational process. The second thing we evaluate, of course, is the degree to which the product meets its objectives. To bring about educational improvement, a new product or process must meet both of these conditions.

The feedback that we obtain from field testing is, of course, brought back into the Laboratory and used as a basis for revising the Minicourse. This revision is again tested in the field and feedback and evaluation data are again obtained. This cycle of field test, evaluate, revise should be continued until the product meets its educational objectives

and is perceived favorably by most users. You will note on the handout that Minicourses typically undergo three field tests and revision. Each field test in our cycle of technological development has slightly different purposes but the basic purpose, that is, evaluating the product's effectiveness and getting feedback for further improvement is essentially the same. We have found three field tests to be sufficient for most Minicourses although on a few occasions a fourth test has been necessary in order to bring the course up to the point where its educational objectives are met. The final steps in the development of Minicourses are aimed at preparing the course for widespread use, disseminating the course and assisting with its implementation in the schools. At present, we feel much less confident of our ability to disseminate our courses and bring about their widespread use than we do in our ability to develop courses that bring about substantial improvements in teaching. Our courses are currently being released by a commercial publisher, but I do not really know whether this is the best approach to achieve widespread implementation. The advantages of the commercial publisher are, briefly, that such publishers are experienced in widespread product dissemination and have a corps of trained salesmen in the field who are already in contact with educators. Surely, the biggest disadvantage of the commercial publisher is that the cost of an educational product goes up a great deal when it is distributed through commercial channels.

I would like to make one additional point concerning the use of a rigorous research and development process, that is, this type of work is difficult, time consuming, and expensive. The R & D cycle we follow requires field testing and revising each Minicourse at least three times

and provides for the collection of pre- and post-course performance data to determine if teachers taking the course can perform the skills in their regular classrooms. A typical minicourse requires about 18 months to carry through our complete R & D cycle. During this time about seven thousand man-hours of effort are expended on the course. The average cost of developing a Minicourse has been nearly $107,000. Of this amount, review of the literature and planning has cost about $8,000. Carrying out three field tests and evaluating the results of these tests for each course has cost an average of $40,000. Developing the initial form of the course and making major revisions after the field tests has cost approximately $52,000. The remaining $7,000 has been devoted to preparation of final reports and expenses incurred in dissemination and implementation. However, it should be remembered that most of the dissemination and implementation costs are borne by the commercial publisher. The cost to the publisher of taking a fully developed and tested Minicourse, producing this course commercially and putting it on the market has been about $50,000 per course.

In view of these costs, you may ask: Is rigorous technological development of educational products really feasible from an economic standpoint? I would assert most strongly that it is for two important reasons. First, this type of development leads to real improvement in education, that is, a product developed following the process that we use at the Far West Laboratory is demonstrably superior and, since it involves training teachers, can be expected to have a long-range effect on the learning of a great many children for each teacher who is trained. The second reason that I regard such development to be a wise educational investment is that,

although the cost of developing an educational product is high, if such products are broadly implemented, the unit cost per user of such development is small. If we take our first Minicourse as an example, there are about 614,000 teachers in elementary schools in the United States who are at the appropriate grade levels for this course (Simon & Grant, 1968). If one out of every ten teachers takes this course, the development cost per teacher will be only $1.63. And in the case of Minicourse 1, there is a good chance that the federal money spent to develop this course will be returned to the U. S. Treasury. In fact, if the commercial publisher's market research is correct, the Treasury will receive royalties that exceed our development costs by about $160,000*. Thus, although the research-based development of educational products is expensive, this process is by far the most economical that we now have for bringing about significant nationwide improvements in educational practice.

In addition to cost-effectiveness, a rigorous development approach has several other advantages over both local innovations and research. First, it provides the educational practitioner with a product that is fully ready for operational use. Therefore, implementing an educational product that has undergone development is much easier and much less likely to fail than implementing an innovation such as team teaching in which each user must re-invent most of what he needs to put his program into effect.

Second, a product of educational development carries with it rigorous research evidence that it does the job for which it was designed. For

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* Minicourse 1 is being marketed by Macmillan Educational Services, Inc., 8701 Wilshire Boulevard, Beverly Hills, California

example, to test the effectiveness of our Minicourses, we make videotape recordings of the teacher's actual classroom performance before and after the course. If these videotapes do not show significant improvements in the teaching skills covered in the course, we continue to revise and field test the course until such gains are obtained. Only then do we release the course for operational use in inservice training programs. Thus, when the educator adopts a product that has been developed by the R & D process, he can expect an improvement in his educational program, not just a change. Since education is such a huge enterprise, even small educational improvements, when applied widely, can bring about cost effectiveness gains worth millions of dollars. If, through educational development, we can put together enough small improvements we can bring about a quiet revolution in our schools.

Another important advantage of educational development is that it provides an effective means of enlisting both local innovation and educational research in the task of building a better educational system. For example, if a promising local innovation is subjected to the development process and proves to be effective, it can become a lasting national improvement instead of a passing local fad. Furthermore, the research knowledge that in the past has made little impact on educational practice can make an important contribution if it is used as the raw materials out of which a better educational product is built.

Our few years of experience with educational development indicates that we finally have a process that can bring about real improvements in educational practice. Since this approach is new to education, many of the products developed to date, such as some of the new mathematics and

science curriculums, have been built using an inadequate R & D process in which essential steps have often been overlooked. For example, most of these curriculum developments initially failed to include sufficient training materials to prepare teachers to use the curriculum effectively. This failure, of course, is a violation of the R & D principle that a product should include everything needed to use it effectively in an operational situation. The result of this oversight was that such curriculums were often badly misused by teachers. However, most of the early developers have now gone back and corrected this serious deficiency. On the other hand, most of the current development programs such as the SCIS Elementary Science Curriculum, the Minicourse, the Southwest Regional Laboratory's Reading Program and the IPI Curriculum, are using the R & D process more skillfully to build products that are of proven effectiveness and that contain everything needed for implementation.

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Far West Laboratory for Educational Research and Development

THE 27 STEPS IN THE DEVELOPMENT PROGRAM
By Walter Borg and Paul Hood

Procedures

The procedures established to implement the program stategy for the Teacher Education Program are an outgrowth of the Laboratory-wide research and development strategy. At the present time, the Teacher Education Program has established 27 specific steps. The number of steps actually executed is, of course, dependent on the nature of the product being developed. They are as follows:

A. Research and Information Collecting

1. Review literature and prepare report.

B. Planning

2. State the specific objectives or behavioral changes to be achieved and plan a tentative course sequence.

C. Develop Preliminary Form of Product

3. Prepare scripts for the instructional lessons.
4. Prepare teacher handbook and evaluation forms for use in the microteach evaluation.
5. Prepare instructional tapes; record, edit and dub.
6. Prepare model tapes; record, edit, and dub.

D. Preliminary Field Testing

7. Conduct preliminary field test in 1 to 3 schools, using 4 to 12 teachers.
8. Evaluate results of field test.

E. Main Product Revision

9. Revise scripts based on preliminary field-test results.
10. Revise handbook and evaluation forms and print for main field test.
11. Revise instructional tapes; record, edit, and dub.
12. Revise model tapes; record, edit, and dub.
13. Prepare follow-up package to be used by teachers during nin months completion of the course.

F. Main Field Testing

14. Conduct field test using a sample of 30-75 teachers.
15. Collect pre-course tapes and post-course tapes of the classroom behavior of teachers participating.
16. Collect delayed post-course tapes of participating teachers from four to six months after completing the course.
17. Evaluate main field-test results to determine if the course meets the specific behavioral criteria established for the course.
18. Distribute the avaluate follow-up package.

G. Operational Product Revision

19. Revise course for operational field test.
20. Prepare complete implementation package including all material needed by a school to conduct the course without outside help.

H. Operational Field Testing

21. Train operational test coordinators.
22. Conduct operational field test.
23. Evaluate operational field-test results.

I. Final Product Revisions

24. Make final revisions in the minicourse prior to mass distribution of the course for operational inservice use in the schools.

J. Dissemination and Distribution

25. Disseminate and distribute course for use.

K. Report Preparation

26. Prepare and distribute research and development report, giving results of all field testing of the minicourse.

L. Implementation

27. Implement course in the schools.